CHEMICAL EVENT REFERENCE GUIDE

FOR

HEALTHCARE PROVIDERS

Virginia Department of Health
Emergency Preparedness & Response Programs

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
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CHEMICAL RELATED ILLNESSES

Adequate planning and regular training are key to preparedness for chemical accidents or terrorist attacks involving a chemical release.

In the event of a chemical accident or attack, healthcare workers will need to rapidly assess and treat the casualties. However, there may be minimal information about the agent(s) involved at the time. This guide is intended to provide a summary of critical information for healthcare providers to assist in safely diagnosing and managing chemical-related illnesses.

Healthcare providers should be alert to illness patterns and reports of chemical exposure that might signal an act of terrorism. The following clinical, epidemiological and circumstantial clues may suggest a possible chemical terrorist event:

- An unusual increase in the number of people seeking care, especially with respiratory, neurological, dermatological or gastrointestinal symptoms
- Any clustering of symptoms or unusual age distribution (*e.g.,* chemical exposure in children)
- Location of release not consistent with a chemical's use
- Simultaneous impact to human and animal populations
- Any unusual clustering of patients in time or location (*e.g.,* persons who attended the same public event)

Any unusual symptoms, illnesses or clusters should be reported immediately to the local health department. The Poison Control Center should also be notified (800-222-1222).

DIAGNOSIS AND MANAGEMENT GUIDELINES

Table 1 provides an overview of potential chemical exposures, as well as typical clinical effects useful in diagnoses.

TABLE 1
DIAGNOSING CHEMICAL EXPOSURES

Agent Type	Agent Names and Characteristics	Clinical Effects
Nerve (Acetylcholinesterase Inhibitors)	- Cyclohexyl sarin (GF) *Colorless liquid; odorless* - Sarin (GB) *Colorless liquid; odorless* - Soman (GD) *Colorless liquid; fruity or camphor odor* - Tabun (GA) *Colorless to brown liquid; fruity odor* - VX *Colorless to amber-colored, oily liquid; odorless*	- **Miosis (pinpoint pupils)** - **Copious secretions (sweating, pulmonary secretions, salivation, tearing, runny nose)** - **Muscle fasciculations, muscle fatigue to paralysis** - Blurred/dim vision - Headache, nausea, vomiting, diarrhea - Breathing difficulty - Loss of consciousness - Seizures
Blistering/Vesicant	- Mustard agents (H, HD, HN) *Colorless to brown oily liquid; burning garlic or horseradish odor* - Lewisite (L) *Colorless-to-black oily liquid; geranium-like odor* - Phosgene oxime (CX) *Colorless solid or liquid; Pepperish or pungent odor*	- Severe irritation - Redness and blisters of the skin - Lewisite has immediate burning pain - Phosgene oxime causes immediate pain - Tearing, conjunctivitis, corneal damage - Mild respiratory distress to marked airway damage
Asphyxiant/Blood	- Arsine (SA) *Colorless gas; nonirritating garlic odor* - Cyanogen chloride (CK) *Colorless gas or liquid; possible bitter almond odor* - Hydrogen Cyanide (AC) *Colorless gas or crystal; possible bitter almond odor*	- **Possible cherry red skin** - **Possible cyanosis** - **Possible frostbite*** - Confusion - Nausea - Patients may gasp for air, similar to asphyxiation but more abrupt onset - Seizures prior to death
Choking/Pulmonary	- Chlorine (CL) *Greenish-yellow gas; pungent odor* - Hydrogen chloride (HCl) *Colorless/yellowish gas; pungent odor* - Nitrogen oxides (NO, NO_2) *Colorless gas; sweet odor* - Phosgene (CG), Diphosgene (DP) *Gas; Newly-mown hay/grass odor*	- **Possible frostbite*** - Eye and skin irritation - Airway irritation - Dyspnea, cough, wheezing - Sore throat - Chest tightness

*Frostbite may occur from skin contact with liquid arsine, cyanogen chloride or phosgene.
- Clinical effects in **bold** indicate possible distinguishing/characteristic signs or symptoms.
- Some agents have characteristic odors. However, odor is not a safe or reliable characteristic - some people can not detect certain odors, or they may become desensitized over time.

Table 2 provides an overview of actions recommended for decontamination and treatment for individuals exposed to chemical agents.

Proper decontamination is often the most important first step in treating a patient exposed to chemical agents. Immediate removal of the patient's clothing can remove up to 90 percent of the contaminant. Removed clothing should be double-bagged, sealed and retained as possible evidence. It is critical to the health and safety of personnel involved in response and decontamination efforts that PPE appropriate for the type of exposure is used (refer to section on PPE later in document).

TABLE 2
DECONTAMINATION AND TREATMENT OF CHEMICAL EXPOSURES

1. Decontamination of patients for all chemical events:
- Immediately remove clothing (for frostbite areas wash with plenty of warm water to release any adherent clothing)
- Gently wash skin with soap and water
- Do not abrade skin
- For eyes, flush with plenty of water or normal saline

NOTE: For equipment/hard surfaces use dilute bleach (1 part household bleach: 9 parts water)

2. Treatment: First Aid
Assess Airway/Breathing/Circulation (ABCs)
Ventilatory support as necessary

3. Agent-Specific Therapy:

Agent Type	Therapy (Also See Table 3)	Other Considerations
Nerve (Acetylcholinesterase Inhibitor)	- Atropine before other measures - Pralidoxime (2-PAM) chloride - Anti-convulsant	- Onset of symptoms from dermal contact with liquid forms may be delayed - Repeated antidote administration may be necessary
Blistering/Vesicant	- Immediately decontaminate skin - Flush eyes with water or normal saline for 10-15 minutes - If breathing difficulty, give oxygen - Thermal burn therapy, supportive care - Specific antidote British Anti-Lewisite (BAL) may decrease systemic effects of Lewisite	- Possible pulmonary edema - Mustard has an asymptomatic latent period - There is no antidote for mustard - Lewisite causes blisters
Asphyxiant/ Blood	- Rapid treatment with oxygen - For cyanide, use antidotes (sodium nitrite, then sodium thiosulfate)	- Arsine and cyanogen chloride may cause delayed pulmonary edema
Choking/Pulmonary	- Fresh air, forced rest - Semi-upright position - If signs of respiratory distress are present, oxygen with or without positive airway pressure may be needed - Other supportive therapy, as needed	- May cause delayed pulmonary edema, even following a symptom-free period that varies in duration with the amount inhaled

TABLE 3
ANTIDOTE RECOMMENDATIONS

Agent	Patient	Antidotes	Other Treatment
Nerve[1]	**Infant, Child**[2]	Atropine: 0.05-0.1 mg/kg IM, IV **or** IO (max 5 mg); **and** 2-PAM: 25-50 mg/kg IM **or** slow IV[7] (max 2 gm)	Assisted ventilation for severe exposure. **Diazepam** for convulsions: (0.2 mg/kg slow IV for children or 10 mg slow IV for adults).
	Adult[3]	Atropine: 2-5 mg IM **or** IV; **and** 2-PAM: 1,000-2,000 mg IM or slow IV[7]	
	All	Reassess frequently. If no improvement: Repeat atropine (0.05-0.1 mg/kg IM, IV or IO for children or 2 mg IM or IV for adults) q5 to 10 minutes **until secretions diminished/breathing is comfortable or airway resistance has returned to near normal** **Repeat** 2-PAM (25-50 mg/kg IM or slow IV[7] for children or 1,000 mg IM or slow IV[7] for adults) q1hour	
Lewisite	**All**	For mild exposure: None For severe exposure (shock, significant pulmonary injury): British Anti-Lewisite (BAL; Dimercaprol): • Eye exposure – BAL ophthalmic ointment • Skin exposure – BAL ointment • Pulmonary – BAL 3 to 5 mg/kg deep IM q4h x 4 doses	BAL dosage depends on exposure severity and symptoms.
Cyanides	**Infant, Child**	If patient is conscious and has no other signs or symptoms, antidotes may not be necessary. Sodium nitrite[4,5]: 0.12 - 0.33 ml/kg, not to exceed 10 ml of 3% solution[6] slow IV over 5 - 10 minutes, or slower if hypotension develops **and** Sodium thiosulfate: 1.65 ml/kg of 25% solution IV over 10-20 minutes	For sodium nitrite-induced orthostatic hypotension, normal saline infusion and supine position are recommended.
	Adult	If patient is conscious and has no other signs or symptoms, antidotes may not be necessary. Sodium nitrite[4,5]: 10 - 20 ml of 3% solution[6] slow IV over 5 - 10 minutes, or slower if hypotension develops **and** Sodium thiosulfate: 50 ml of 25% solution IV over 10 - 20 minutes	If still apneic after antidote administration, consider sodium bicarbonate for severe acidosis.

1. Dosages are symptom-dependent: lower doses for mild/moderate effects (sweating, fasciculations, weakness, dyspnea); higher doses for severe effects **(**convulsions, apnea, flaccid paralysis).
2. If calculated dose exceeds the adult dose, adjust accordingly.
3. Reduce atropine and 2-PAM Chloride dosages for elderly patients.
4. If sodium nitrite is unavailable, administer amyl nitrite by inhalation (1 ampule every 5 minutes).
5. If patient has recent smoke inhalation (high carboxyhemoglobin), administer only sodium thiosulfate.
6. Available in commercial Cyanide Antidote Kits.
7. Slow IV = over 20 – 30 minutes.

NOTE: 2-PAM Chloride is Pralidoxime Chloride or Protopam Chloride.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

DO NOT BECOME A CASUALTY!

If patients have been successfully decontaminated, then use of **Standard Precautions** is appropriate for administering to their needs. Prior to decontamination, though, the following guidance on protective measures and use of PPE should be considered.

Patients whose skin or clothing are covered with liquid or solid chemical may contaminate personnel and the treatment facility by direct contact or by off-gassing vapor. **If the patient has ingested a chemical, toxic vomitus may also pose a danger through direct contact or off-gassing vapor**. Many substances, when ingested or inhaled, may emit residual products which can pose a hazard to the responder or healthcare provider, even if external contamination is not present. This can be particularly dangerous in CPR or post-mortem situations.

To protect yourself:

- Be alert
- Keep an appropriate distance
- Use appropriate PPE (on which you have been trained and fit-tested)

To help protect the healthcare worker against exposure to chemical agents including respiratory, dermal, and eye exposures, a PPE ensemble including the following components should be considered:

- Respiratory equipment (filtering facepiece, APR, PAPR, SCBA)
- Protective clothing (suit, coveralls, apron, hood, gloves, boots)
- Eye protection (goggles, face shield, or full-face mask respirator)

Respirators: Protection from both vapors and particulates is needed when a chemical agent is present. Standard surgical masks **will not** protect against inhaling vapors or particulates. While filtering facepiece respirators (“dust masks”) such as the N95 mask can help protect against inhalation of particulates (dust, fumes, mists), they **will not** protect against inhalation of gases & vapors. Half-face mask and full-face mask air-purifying respirators (APRs) may provide adequate protection from both particulates and gases/vapors **as long as they contain the appropriate filter/cartridge**. Powered air-purifying respirators (PAPRs) may provide even better respiratory protection. The highest level of protection is provided by atmosphere-supplying respirators such as the air-line respirator or self-contained breathing apparatus (SCBA), especially when used in conjunction with a fully encapsulated suit.

Protective Clothing: Protective clothing includes chemical suits, coveralls, aprons, hoods, gloves, and/or boots. PPE can be divided into three categories based on the degree of protection afforded. Level A consists of a fully encapsulated suit offering the highest level of liquid and vapor protection. Level B consists of a liquid splash resistant ensemble, which can be encapsulated or non-encapsulated. Level C consists of a non-encapsulated liquid splash resistant suit. All three levels offer sufficient protection against particulates and most liquid splashes. Latex gloves provide inadequate protection from most chemical agents. Chemically resistant gloves made of Viton, nitrile, butyl rubber, or neoprene are more appropriate for chemical exposures. An additional pair of thicker, outer gloves adds a layer of protection and may be necessary for some exposures.

Eye Exposure: In addition to dermal protection, it is crucial that PPE protect the eyes from chemical exposure that can occur during patient care and decontamination. Most of the respirators described above (full-face respirators, PAPRs, SCBAs), with the exception of dust masks and half-face masks, will provide adequate eye protection. Goggles and face shields, which are often used to protect against particulates and liquid splashes, **will not** provide protection from chemical gases & vapors.

DISCLAIMER

The information contained in this document is intended to be a guide and is not intended to be comprehensive. This information, or the Web sites and references listed herein, are not a substitute for professional medical advice, diagnosis, or treatment of the individual. Please consult other references and check antidote dosages, particularly for children and pregnant women.

REFERENCES AND RESOURCES

- Virginia Department of Health – Emergency Preparedness and Response (EP&R)
  http://www.vdh.virginia.gov/EPR/Agents_Chemical.asp

- Textbook of Military Medicine – Medical Aspects of Chemical and Biological Warfare

  And

  Medical Management of Chemical Casualties Handbook, Third edition. U.S. Army Medical Research Institute of Chemical Defense (USAMRICD). Aberdeen Proving Ground: Aberdeen, MD
  http://ccc.apgea.army.mil/products/handbooks/books.htm
  Note: online access requires user registration

- Centers for Disease Control and Prevention Public Health Emergency Preparedness and Response
  http://www.bt.cdc.gov/Agent/index.asp - Click on link for Chemical Agents

- Agency for Toxic Substances and Disease Registry (ATSDR). 2001. Managing Hazardous Materials Incidents Vol. I, II, III. Division of Toxicology, U. S. Department of Health and Human Services. Public Health Service: Atlanta, GA
  http://www.atsdr.cdc.gov/mhmi.html

- U.S. Army Edgewood Research, Development and Engineering Center. 1999. Technician EMS Course. Domestic Preparedness Training Program, Version 8.0. U.S. Army SBCCOM. Aberdeen Proving Ground: Aberdeen, MD